5 2ND VISIT DEMONSTRATION FARM

NFUScotland

East Knockbrex: Anaerobic Digestion Plant

East Knockbrex,
Newton Stewart,
DG8 6QE

Farmer – Iain Service
Date of Farm Visit – 2nd December 2014

Iain Service has installed a 150kWe (130kWth) Anaerobic Digestion plant on his newly built dairy farm which houses 550 cattle

Background

East Knockbrex is a new-build dairy farm complex with capacity for 600 cows, located to the southwest of Newton Stewart. The farm currently holds 550 milking cows and has an anaerobic digestion (AD) plant integrated into its operations.

The AD plant at East Knockbrex has a designed electrical output of 150kWe and a heat output of 130kWth. Once fully operational the AD plant will be central to the functioning of the dairy operation, supplying both electricity and heat from its combined heat and power (CHP) engine to the dairy unit building and processes.

Key changes since 1st visit in February 2014:

- Construction of AD plant completed
- FIT application submitted
- Increased capital costs
- Plant delivered later than expected
- Plant commissioning started
- New RHI tariff introduced in July 2014

The Scheme

The plant equipment was designed, supplied and built by Fre-energy, a specialist technology provider who build small AD plants specifically designed to process farm manures and wastes.

The development costs were kept down as Iain Service undertook some of the works himself including laying foundations and prefabricating a number of plant components. Capital costs for the construction of the plant were approximately £900,000, which is higher than the £600,000 estimated at the previous RDI visit in February 2014. The capital cost for grid connection was £50,000 although this was helped by the new connection to the farm. The planning consent for the scheme was achieved as part of the application for the rest of the farm.

The AD plant was energised on the 14th October and it is estimated that commissioning will take approximately three months as Fre-energy fine tune the plant.

At present, only cow slurry is used for feedstock. Once a stable process is created other feedstocks will be introduced.

FIT and RHI Accreditation

Feed-in-Tariff (FIT) pre-accreditation for the project was submitted in December 2013 to secure a FIT rate of 12.46 (RPI adjusted). The full FIT application has now been made but OFGEM have come back to Iain with 10 supplementary questions to complete before they will accredit the scheme.

Iain is in the process of submitting a RHI application for which the AD plant is also eligible for payments under the Renewable Heat Incentive (RHI) at 7.5p/kWh for all heat used for eligible purposes.

The European Agricultural Fund for Rural Development: Europe investing in rural areas
SMITHSGORE
The Scottish Government

Supply of Feedstock

Each head of cattle will produce around 450 litres (or kilograms) of slurries per week, which equates to approximately 12,800 tonnes of slurry feedstocks annually. Cattle slurry will be the main feedstock used in the AD plant. Some supplementary feedstocks such as grass silage, poultry manure and arable by-products may be used in the future. These additional feedstocks will help to improve the efficiency of the plant and maximise energy yields, although Iain would like to keep the amount of grass silage used to the minimum required, preferring to supply it to his cows.

Iain is considering keeping the cattle indoors all year round in order to maximise the capture of slurries.

AD Process

The AD facility at Knockbrex Farm will be a mesophilic digester. Iain expects the input of 12,800 tonnes of slurry which will generate about 75kw output and 470,000 kWhe per year. The remaining capacity will be achieved by the input of solid feedstocks such as manures, grass silage or failed crops. The amount of grasss silage added to the system will have to be carefully managed as too much can disrupt the digestion process. These feedstocks have higher caloritic value than cow slurry and as such, 2,700 tonnes of additional feed stock will allow the plant to achieve full capacity and generate 1,000 MWh per year.

A by-product of the AD process is a semi-solid residue known as digestate which can be used as a fertiliser. A summary of the nutritional value from cow slurry based digestate is shown below.

Tonnage of slurry produce p.a.	Typical nutrient value of whole cattle slurry based digestate (kg/tonne)			Percent of nitrogen available to crop when band spread in:			
	N	P	K	Spring	Summer	Autumn	Winter
128,000	2.6	1.2	3.2	40%	30%	30%	25%
Source: SRUC's Technical Note TN650 (April 2013)							

Financial Figures

The current net electricity output from the plant (operating as a slurry only system) is estimated to be in the region of 470,000kWhe annually after parasitic losses from the operation of the plant are accounted for - this has a capacity factor of 36%. These figures do not account for the value of the digestate as fertiliser which will hold additional value.

The table below details the headline figures associated with the project. To generate these figures we have assumed that approximately 25% of the heat produced is used for a RHI eligible purpose. The table also shows the potential returns if the project was to run at 90% capacity factor which could be achieved if energy crops were introduced to the system. The project has an approximate payback period of 7.5 years.

Estimated Capital Costs	£900,000	
Capacity factor	36%	90%
Tonnes of slurry	12,800 tonnes	12,800 tonnes
Tonnes of energy crop*	0 tonnes	2,700 tonnes
Electricity produced	470,000 kWh	1,183,000 kWh
Heat produced	400,000 kWh	1,025,000 kWh
FIT income at 12.46p/kWh	£58,500	£147,500
RHI income at 7.5p/kWh**	£7,500	£7,500
Electric export	£11,500	£45,500
Electric savings	£25,000	£25,000
Heat savings***	£6,000	£6,000
Total Revenue	£108,500	£231,500
Operation costs****	£54,000	£108,000
Income	£55,000	£123,000
*e.g. grass silage, whole crop		
**Assumes 100,000 kWh used p.a. (25% of total available)		
***Assumes replacement of LPG		
****Based on 6% CAPEX plus £20 tonne for energy crops		

> AD is a holistic solution that allows us to process slurry to improve fertiliser quality while generating electricity and heat
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> *Iain Service, November 2014*